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STATE OF ALASKA

William A. Egan, Governor

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FEDERAL AID IN FISH RESTORATION PROJECT F-9-2

SPORT FISH INVESTIGATIONS OF ALASKA

ALASKA DEPARTMENT OF FISH AND GAME

Wallace H. Noerenberg, Commissioner

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INTRODUCTION

This report of progress consists of Job Segment Reports from the State of Alaska, Federal Aid In Fish Restoration, Project F-9-2, "Sport Fish Investigations of Alaska".

The studies reported herein are investigations evaluating the sport fish resources of the state. Recreational and other impacts on the fishery resources necessitates a continuous endeavor of ascertaining facts and knowledge of the fisheries. The 24 jobs reported on are of a continuing nature. The investigations are composed of 11 projects involved with the inventory and cataloging of the sport fish waters of the state, sport fishery creel censuses, and access. Fish species that received special investigational effort include: Dolly Varden, anadromous fish, grayling, sheefish, whitefish, pike, char, and salmon. The information gathered from the combined studies provides necessary background data for a better understanding of management problems and constitutes a basis for necessary future investigations.

The subject matter contained in these reports is incomplete, and the findings and interpretations subject to re-evaluation as work progresses.

RESEARCH PROJECT SEGMENT

State: Alaska

Project No.: F-9-2 *Name:* Sport Fish Investigations of Alaska.

Job No.: 2-B *Title:* **Investigations of Anadromous Dolly Varden Populations in Hood Bay Drainages, Southeastern Alaska.**

Period Covered: July 1, 1969 to June 30, 1970.

ABSTRACT

This report presents the results of the fifth year of study at Hood Bay and the eighth year of investigation on the life history of Dolly Varden, Salvelinus malma. Emphasis of study included a smolt transplant experiment from the North Arm streams to Hood Bay Creek, homing and straying of Dolly Varden at maturity, and habitat preferences and intra-stream movements of rearing Dolly Varden and coho salmon, Oncorhynchus kisutch, at Hood Bay Creek.

A total of 7,726 Dolly Varden smolts was estimated to have left Hood Bay Creek in 1969. Of these, 5,160 left from early May to late June and 2,566 from late September to mid-November. A total of 1,123 Dolly Varden smolts was transplanted from the North Arm streams to Hood Bay Creek.

An estimated 7,904 Dolly Varden entered Hood Bay Creek from the sea in 1969. Of these, 1,608 were classed as potential spawners and 6,296 as nonspawners.

Of the spawned-out Dolly Varden captured (n=882) leaving Hood Bay Creek in 1969, 75% (n=661) had been marked as originating from the system as smolts, or as having spawned in the system in a previous year. No straying was found to occur between Dolly Varden spawning in the three Hood Bay study streams.

Population estimates of 52,737 Dolly Varden and 24,029 coho salmon were calculated for these species rearing in Hood Bay Creek. A similar rearing environment with a preference for sheltered pools, sloughs, and undercut banks was indicated for both rearing Dolly Varden and coho salmon. Dolly Varden were found to select most of their food from the stream bottom; coho salmon selected most of their food from the water surface.

RECOMMENDATIONS

The number of anglers fishing for Dolly Varden is increasing each year. This is due to normal population growth and especially to the rapid increase of tourists coming to Alaska. Logging of watersheds containing Dolly Varden is also on the increase. To meet these increased fishing pressures and to determine the effects logging may have on Dolly Varden, the study should be expanded into the following jobs:

1. Life History of Dolly Varden: This job is essentially a continuation of the present study, although emphasis should be placed on areas of immediate management importance. Freshwater rearing requirements, feasibility of smolt transplants, and homing capabilities of Dolly Varden should be emphasized.

2. Effects of Logging on Dolly Varden: No information is available on this subject. The habit of young char rearing for three to four years in small tributaries frequently altered by logging emphasizes the importance of this job.

3. Dolly Varden Sport Fishery - Juneau Area: No information is available on the abundance of Dolly Varden along the road system of Juneau. Since this area receives the greatest fishing pressure on Dolly Varden in Southeast Alaska, a determination of the status of these stocks and their management needs is important.

4. Dissemination of Information Collected on Dolly Varden: Although most of the basic life history information collected on Dolly Varden has been published, a substantial amount of information important for formulating specific management practices has not been published. This job will allow for an orderly dissemination of information through publication in fishery journals.

Management

Successful management of anadromous Dolly Varden populations will require a thorough understanding of their complex migration habits. Of special importance will be the management of key wintering areas such as lakes and larger river systems. These areas may harbor populations of fish originating from streams over a vast area from five to nine months each year. A depletion of fish in a wintering area could severely reduce or eliminate populations belonging to many stream systems. For instance, a reduction in the number of Dolly Varden in a lake from 100,000 to 10,000 may not noticeably affect the catch success in that lake system, but could seriously reduce the catch in the non-lake streams which have only populations of two to five thousand, and for which these fish were destined.

Anadromous fish lakes in Southeastern Alaska will become prime recreation areas as human populations increase and as the land becomes developed. Industry, power projects, resorts, and residential development will probably not be compatible with maintaining a large wintering population of fish. Selected major Dolly Varden wintering areas free from development should be set aside and fishing pressures in these areas regulated to provide the protection needed for the stocks belonging to other streams.

OBJECTIVES

Information was obtained on all objectives planned for the 1969 field season. The objectives were:

1. Determine the number and timing of Dolly Varden and coho smolts leaving the Hood Bay streams.

2. Determine the size, sex, and food of Dolly Varden and coho leaving the Hood Bay streams.

3. Determine if Dolly Varden smolts and pre-smolts, transplanted from the North Arm streams to Hood Bay Creek in the South Arm will return to Hood Bay Creek at maturity.

4. Determine the number, by age group, of rearing Dolly Varden, coho, and cottids in Hood Bay Creek.

5. Determine the degree and reasons of intra-stream movement of rearing Dolly Varden, coho, and cottids in Hood Bay Creek.

6. Design and instigate experiments which will determine if competition for rearing space between Dolly Varden and coho salmon young in Hood Bay Creek exists, and if so, to obtain an

indication of the effects this competition may have on the rearing capacity of Hood Bay Creek for each of these species.

7. Determine factors controlling the rearing capacity of streams for Dolly Varden and coho young.

8. Determine the number and timing of Dolly Varden entering Hood Bay Creek.

9. Determine the size, age, sex, and maturity of Dolly Varden entering Hood Bay Creek.

10. Design and instigate experiments which will determine the stimuli used by Dolly Varden to locate their home streams at maturity and the stimuli used by the immature and spawned-out char to locate a lake to winter in.

11. Determine the number of char originating from Hood Bay Creek which home to the system for spawning and the number straying to the North Arm streams for spawning.

13. Determine the percent mortality of Dolly Varden after spawning, by sex.

14. Determine the number and timing of Dolly Varden leaving Hood Bay Creek.

15. Determine the timing of pink and chum salmon young leaving Hood Bay Creek.

16. Determine the number and timing of salmon entering Hood Bay Creek.

TECHNIQUES USED

All Dolly Varden smolts captured at the Hood Bay Creek weir were measured (fork length in mm) and finclipped (left ventral - spring outmigration; both ventral - fall outmigration) or sampled. Each smolt sampled was measured, weighed, and dissected to determine sex and stomach content. Otoliths were obtained from those sampled, and ages were determined immediately under a binocular microscope.

Smolts to be transplanted from the North Arm streams to Hood Bay Creek were obtained at weirs across the two streams. The fish were held for three days in Hood Bay Creek before release. All those released were finclipped with right ventral and adipose marks.

Inmigrant Dolly Varden captured at the Hood Bay Creek weir were measured and examined for finclips or tags. A hole was punched in the upper portion of the caudal fin of all Dolly Varden released. Samples of the inmigrant Dolly Varden were taken to determine age, sex, and maturity. Outmigrant Dolly Varden captured were measured and examined for finclips or tags. Spawned-out fish were sexed by external characteristics, finclipped (adipose) and tagged with internal anchor tags.

All spawned-out Dolly Varden captured at the North Arm streams weirs were measured, sexed, and examined for finclip or tag.

Removal of the weir screens during high water periods caused some fish to be missed. Therefore, a marked-to-unmarked ratio of the outmigrants (Peterson estimate) was used to estimate the total number of Dolly Varden that had entered Hood Bay Creek. The estimated inmigration for Hood Bay Creek was computed as follows:

$$\frac{\text{1,540 unmarked outmigrants}}{\text{1,734 marked outmigrants}} \times \frac{\text{Estimated number missed}}{\text{3,889 number available for recapture (marked)}} = \text{3,454 total fish missed}$$

3,454	estimated number missed
+3,889	number available for recapture
+ 479	fish sampled
+ 82	fish dead
7,904	estimated inmigrants

Ultrasonic transmitters were implanted in the body cavities of two Dolly Varden by making a surgical incision near the ventral fins. The fish were held at the weir for three days before displacement to salt water. They were tracked with a directional hydrophone and receiver.

Double-funneled minnow traps were periodically set throughout Hood Bay Creek to determine habitat preferences, distribution, movement, and abundance of Dolly Varden and coho salmon young rearing in Hood Bay Creek. All fish captured were measured and branded using a silver wire dipped in boiling water. Samples were taken for age determination.

FINDINGS

These findings are the result of information collected on Dolly Varden in Hood Bay from May through November, 1969. For information collected on Dolly Varden in prior years see Armstrong (1963; 1965a; 1965b; 1965c); Armstrong and Blackett (1966a; 1966b); Armstrong and Kissner (1969); Armstrong and Morton (1969); Armstrong and Winslow (1968a; 1968b); Blackett (1968); Blackett and Armstrong (1965a; 1965b); and Heiser (1966).

Dolly Varden Smolts

A total of 7,726 Dolly Varden smolts was estimated to have left Hood Bay Creek in 1969. Of these, 5,160 left from early May to late June and 2,566 from late September to mid-November. The spring migrants sampled (n=226) were mostly from age groups III (60%) and IV (28%) and the fall migrants sampled (n=199) were mostly from age groups II (81%) and III (18%). Most of the smolts were between 100 - 190 mm in fork length with a mean length of 134 mm. The spring smolts averaged 129 mm and the fall smolts averaged 146 mm. The male-to-female ratio of the sampled smolts was 47:53 (n=450). Food of the spring smolts consisted mostly of insects and pink and chum fry. The smolts sampled in the fall had fed primarily on salmon eggs.

Smolt Transplant

A total of 1,123 Dolly Varden smolts captured at weirs on the two North Arm streams was transported to Hood Bay Creek, finclipped, and released. This experiment was conducted to determine the feasibility of transplanting smolts as a means of establishing or enhancing Dolly Varden populations in depleted systems.

During the entire process of collecting, holding, transporting, and finclipping these smolts, only one mortality was recorded. Of the transplanted smolts released, 26% returned the same year. This was more than the percentage return of spring smolts (18%) originating from Hood Bay Creek.

Inmigrant Dolly Varden

A total of 7,904 Dolly Varden was estimated to have entered Hood Bay Creek from the sea in 1969. Of these, 1,608 were considered to be potential spawners for the year and 6,296 were classed as nonspawners. Substantial numbers of fish entered the system from mid-July through mid-October. The number of potential

spawner and nonspawner Dolly Varden entering Hood Bay Creek in 1969 is presented by month in Table 1.

TABLE 1 Monthly Inmigration of Potential Spawner and Nonspawner Dolly Varden at Hood Bay Creek, 1969.

	Total sample	Spawners in sample		Estimated inmigration	Estimated number of spawners	Estimated number of nonspawners
		n	%			
June	0	0	0	0	0	0
July	91	9	9.9	1,288	127	1,161
August	171	62	36.3	1,636	594	1,042
September	116	24	20.7	3,146	651	2,495
October	101	13	12.9	1,826	236	1,590
November	0	0	0	8	0	8
Totals	479	108	20.3*	7,904	1,608	6,296

*weighted

Sex ratio of the potential spawners entering Hood Bay Creek was 65% female and 36% male. The number of female and male Dolly Varden entering the system to spawn during the study years 1966-69 is presented in Table 2.

TABLE 2 Number and Sex of Dolly Varden Potential Spawners Entering Hood Bay Creek, 1966-69.

	1966	1967	1968	1969
Females	988	1,115	1,119	1,029
Males	1,170	684	329	579
Total spawners	2,158	1,799	1,448	1,608
Total nonspawners	3,375	4,155	3,559	6,296
Total inmigration	5,533	5,954	5,007	7,904

Homing

Of the spawned-out Dolly Varden captured (n=882) leaving Hood Bay Creek in 1969, 75% (n=661) had been marked as originating from the system as smolts or as having spawned in the system in a previous year. Of the total examined, 44% (n=392) had been marked as smolts; 31% (n=269) had been marked spawning in the system before and 25% (n=221) were unmarked.

Most of the fish spawning in Hood Bay Creek had probably originated from the system. Ages of up to eight years have been found among the spawners at Hood Bay Creek. Therefore, it is possible that char spawning in 1969 could have originated from the system as smolts as far back as 1963, or four years before the first marking in 1967. Many of these fish would have been marked on a previous spawning migration in 1967 and 1968. The 25% unmarked among the spawned-out Dolly Varden would be expected in 1969 as some of the smolts out-migrating in 1966 would be spawning for the first time in 1969. Also, an estimated 1,926 smolts were missed; hence, they were not marked in 1968. Some of these fish would be expected to return in 1969 and would make up a portion of the unmarked char spawning in Hood Bay Creek.

Straying

Another test of the homing tendencies of Dolly Varden is to determine if any straying from one stream system to another is occurring. The most reliable indicator of straying would be to recover the char marked as smolts from Hood Bay Creek, spawning in other systems. Another indicator would be to record tagged fish spawning in one system one year, and another system the next year.

None of the char marked as smolts originating from Hood Bay Creek were found among the spawned-out Dolly Varden captured (n=572) at the North Arm streams weirs in 1968 and 1969.

Also, none of the spawned-out Dolly Varden tagged at Hood Bay Creek were recorded as spawning in the North Arm streams and none of the fish recorded as spawning in one of the North Arm streams in 1968 was recorded as spawning in the other North Arm stream or in Hood Bay Creek in 1969.

Sonic Tracking Experiments

Preliminary experiments with an ultrasonic transmitter, designed by the Sensory System Laboratory in Tucson, Arizona, were conducted on Dolly Varden from Hood Bay Creek in 1969.

Transmitters were implanted in the body cavities of two Dolly Varden captured at the Hood Bay Creek weir. At separate times they were displaced to a point off the junction of the North and South arms of Hood Bay, a distance of about four miles from their home stream. Both fish had originated from Hood Bay Creek and had been marked during their smolt migration in 1967. They were assumed to be entering the system to spawn.

The first fish released, after moving in a semi-circle near the boat, headed directly to shore. There it remained stationary for about two hours, at which time it began migrating along shore toward its home stream. This migration was steady and the fish did not stop or alter its course until reaching a point off the mouth of its home stream. At this point it appeared to put on a burst of speed and the signal was lost. A considerable amount of searching failed to reveal its presence. A seal was in the vicinity and possibly ate the tagged fish or chased it out of range. This fish was tracked for 3.9 miles in 5.7 hours.

The second fish was tracked for about three hours before its signal was lost. This fish appeared confused and moved back and forth between two points.

Frequency of Spawning

Among the spawned-out Dolly Varden leaving Hood Bay Creek this year, 167 had been tagged during a previous year's outmigration of spawned-out fish. Of these, three had spawned consecutively for the last four years, 40 for the last three years, 98 for the last two years, and the remaining 26 in a year previous to last year.

The frequency of spawning for all Dolly Varden spawners in Hood Bay Creek in 1969 has not been computed. The information has also not been analyzed for mortality after spawning.

Rearing Fish Studies - Hood Bay Creek

Information was gathered on the number of Dolly Varden and coho salmon in Hood Bay Creek, intra-stream movement of these species, habitat preferences, and competition for food and space. This information has not been analyzed and the results presented here are fragmentary and subject to change.

A total of 4,105 Dolly Varden and 1,084 coho salmon young was captured, branded, and released in Hood Bay Creek. A total of 4,528 Dolly Varden and 1,390 coho salmon was later captured and examined for brands. Of the number captured, 327 Dolly Varden and 60 coho salmon were marked. The marked-unmarked ratio indicates a population of 52,737 Dolly Varden and 24,029 coho in the size range taken by minnow traps. This information must be analyzed by length and age before actual population estimates of the fish rearing in Hood Bay Creek can be made.

The fish were distributed throughout the entire accessible waters of Hood Bay Creek. Between June 19 and July 25, the Dolly Varden young showed a preference for upstream areas while coho salmon were more evenly distributed throughout the system. Between August 8 and 24, Dolly Varden young concentrated more in the middle sections and coho salmon tended to concentrate in the upstream areas.

Coho salmon and Dolly Varden appeared to occupy similar areas for rearing. Sheltered pools, sloughs, and undercut banks were preferred to riffles and unsheltered areas.

Intra-stream movement of marked Dolly Varden and coho salmon was recorded for several of the fish. Upstream and downstream movements of up to one mile were recorded.

Samples for stomach content were taken of coho salmon (n=63) and Dolly Varden (n=156) rearing in Hood Bay Creek. The most noteworthy result of this study was the amount of insects taken from the water surface (allochthonus) and below the water surface (autochthonus) by Dolly Varden and coho salmon. Dolly Varden young seldom fed on allochthonus insects while coho salmon young fed heavily on them.

Competition for space between Dolly Varden and coho salmon was investigated by use of experimental troughs with traps. A total of 47 experiments was run using various numbers and combinations of coho salmon and Dolly Varden. The results have not been analyzed. Cursory examination of these results indicates the number of fish in a given area had more effect on displacing the fish than competition between species.

Salmon - Numbers and Timing - Hood Bay Creek

Pink salmon began entering Hood Bay Creek in late July, peaked in early September, and ended in early October. The chum salmon inmigration began in mid-July, peaked in late September, and ended in early November. Coho entered the system from mid-September to the end of November. A total of 15,838 pink, 5,107 chum, and 307 coho salmon was enumerated at the Hood Bay Creek weir in 1969 (Table 3).

TABLE 3 Number of Pink, Chum, and Coho Salmon Entering Hood Bay Creek by Five-Day Intervals, 1969.

Date		Pink	Chum	Coho
July	5- 9	0	0	0
	10-14	0	1	0
	15-19	0	30	0
	20-24	1	267	0
	25-29	25	333	0
August	30- 3	297	358	0
	4- 8	803	65	0
	9-13	1,743	122	0
	14-18	285	17	0
	19-23	105	3	0
	24-28	1,529	24	0
September	29- 2	2,606	147	0
	3- 7	2,769	157	0
	8-12	1,839*	182*	3*
	13-17	2,297	119	2
	18-22	633	658	2
	23-27	745	495	3
October	28- 2	161	1,858	9
	3- 7	0	119	15
	8-12	0	44	15
	13-17	0	11	0
	18-22	0	84	13
	23-27	0	7	3
November	28- 1	0	6	242
	2- 6	0	0	0
Total		15,838	5,107	307

*Includes estimated number of fish missed during high water periods when the screens were removed.

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